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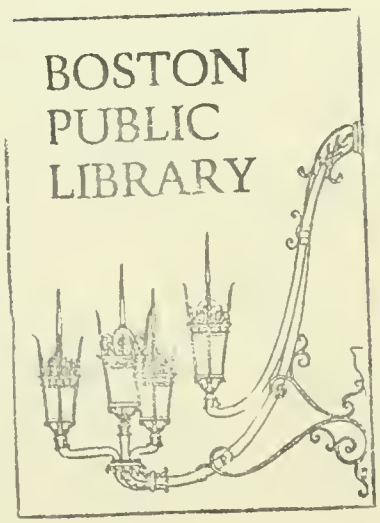
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Transportation Impacts of Alternative Development Scenarios for Charlestown

prepared for the

Boston Redevelopment Authority

by

T A M S

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ENGINEERS ■ ARCHITECTS ■ PLANNERS

May 8, 1989

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A. INTRODUCTION

This report presents the findings of Task 3 of the Transportation Planning Element for the Charlestown Interim Planning Overlay District (IPOD). The purpose of the overall study is to assess general transportation conditions within Charlestown and develop specific recommendations with regard to traffic improvements required to accommodate new development, off-street parking requirements and possible truck route modifications. This interim report addresses transportation issues raised by new development, most of which will occur in the corridor along Chelsea Street from City Square to the Moran Container Terminal. Several major projects have been proposed for this area. Task 3 of the overall transportation element has been completed first in order to address critical issues of access and parking related to this new development.

The primary focus of this task is the Charlestown Navy Yard and immediate environs. Most of the new development which will take place over the next 10 years in Charlestown will occur either in the Yard or in the area along Chelsea Street. Two development scenarios were evaluated as part of this task. The first represented a "maximum build-out scenario", referred to as Developers' Proposed Build-Out or Scenario D. Scenario D includes the largest proposed build-out of the Navy Yard, the relocation of the New England Aquarium to Drydock #2, as well as new commercial development on parcels created by the Central Artery North Area (CANA) project and on Tudor Wharf. The other development option is a "metered build-out" program for the Navy Yard which would take place between now and 2000. This program, referred to as Scenario M, would involve a level of commercial and residential development similar to that proposed by the Boston Redevelopment Authority (BRA) as part of its Master Planning Process in May, 1988. Also included are the relocation of the New England Aquarium and development of Tudor Wharf. Under scenario M a small increment of additional development may be permitted after 1995, if the objectives set for transit ridership and traffic mitigation are met.

Both scenarios assume the completion of the relocated New England Aquarium in the Navy Yard by 1995, and completion of the CANA Project by the same year. In addition, it is assumed that the City Square intersection of Chelsea Street, Rutherford Avenue and the new I-93 ramps would be reconstructed in line with the improvements proposed by the Boston Transportation Department and documented in a report by Vanasse/Hangen/Brustlin in November, 1987. The characteristics of visitation to the New England Aquarium are assumed to be the same as those documented in the report prepared by TAMS for the New England Aquarium (2/15/89). Other assumptions concerning development in Charlestown are documented in the body of this report under the description of each alternative.

B. SUMMARY OF FINDINGS

The results of the transportation analysis clearly demonstrate that the developers' build-out, Scenario D, will cause the failure of the City Square intersection, and that no ready solutions are available to increase the capacity of this intersection to accommodate the forecast level of traffic. Even an increase in transit ridership levels to those found in downtown Boston would not alleviate this situation. In addition, the Gate 5 entrance to the Navy Yard would not accommodate scenario D traffic at peak hour, making severe congestion likely within the Yard itself.

Scenario M, the metered build-out of the Navy Yard, can function from a transportation perspective if a number of actions are taken. These include:

- An additional lane must be added to Thirteenth Street at Gate 5 to allow two lanes of traffic to exit the Yard.

- A signal will be required at Chelsea Street and Medford Street, and this signal must be coordinated with the Gate 5/Chelsea Street signal.

- Gate 1 should be opened to transit vehicles only, since access via Gate 4 is difficult for full-sized transit coaches.

- Parking should be removed from one side of First Avenue and parking regulations, particularly double-parking restrictions, should be strictly enforced.

- Bus shuttle service to the MBTA Rapid Transit and Commuter Rail lines must be provided from the Navy Yard. Service should be provided a minimum of every five minutes during the AM and PM peak periods.

- Water shuttle service must be provided a minimum of every 15 minutes in the peak period by boats with 150-person capacity.

- Van service similar to that provided now must continue, with a minimum of 15-20 vans leaving the Yard in the PM peak period. Service to the MBTA rail lines would be provided by the bus service. Van service would be reconfigured to serve more remote destinations, and could be provided through employers, a transportation management association or the Caravan program.

- An intra-Yard shuttle service will be required to move Aquarium and National Park Service visitors between the parking facilities at Yard's End and the Aquarium site at Drydock #2. This shuttle can also be used by Yard workers and residents. A tram system might be best-suited for this service since most use will occur in the summer months.

- Approximately 5,300 parking spaces will be required in the Navy Yard to accommodate development scenario M. If joint use is permitted between office and residential space, the need would be reduced to 4,500.

- Of this parking supply a minimum of 700 spaces must be dedicated to the exclusive use of visitors and employees of the New England Aquarium on a year round basis. Location of this parking within the Yard's End area is feasible from a traffic circulation standpoint. On peak weekdays in July and August an additional 500 spaces will be required to meet the Aquarium's needs. While a number of options exist for meeting this need both inside and outside the Yard no ideal solution has been identified. On peak Saturdays in July and August as many as 1100 additional spaces must be provided for Aquarium use. Use of the excess weekend capacity in the Building 199 garage is the most likely means of meeting this additional need.

- Parking for school and tour buses must be developed on the land owned by the BRA on the north side of the Little Mystic Channel.

- A signage program beginning at the Route 1 and I-93 ramp terminals in City Square must be developed to direct Aquarium visitors to parking in the Yard's End area.

Additional actions could be taken to assure that the transportation system functions properly. While these are not critical to the successful operation of Scenario M, they would provide a "margin of comfort" and may become necessary if further development is permitted:

- A Transportation Management Association should be formed including participation by the New England Aquarium, private developers in the Yard, major tenants in the Yard, the National Park Service, Charlestown community representatives, the Boston Redevelopment Authority, the Boston Transportation Department, and the MBTA. This organization should be responsible for the management of all transportation services in the Yard, the setting of goals for levels of transit use and ridesharing, the monitoring of goals achievement, and the development of contingency plans should performance fall short of set goals.

- An additional improvement to the City Square intersection, beyond those changes proposed by Vanasse/Hangen/Brustlin, would increase the level of service at the intersection. This improvement would involve the addition of an exclusive right-turn lane from Chelsea Street westbound to Rutherford Avenue northbound. This improvement would require use of a small corner of Parcel 6, a new parcel which will be created by the CANA project.

- Under the development proposal, 700 spaces at Yard's End would be dedicated for use by the Aquarium. Peak visitation months for the Aquarium however, (July and August) coincide with the months when many workers and residents are on vacation. It is thus likely that additional parking capacity, beyond the 700 dedicated spaces, would be available at Yard's End. It may, however, be desirable to limit Aquarium parking within the Yard to 700 spaces (an amount which would meet the demand the other 10 months of the year) and park the summer overflow at a remote site outside of City Square. This would require sophisticated information systems such as electronic signs, but would help to mitigate the impacts of the Navy Yard development on City Square and other intersections in the Chelsea Street corridor.

- As much Yard's End parking as possible should be located north of First Avenue. This will provide relief for a potential congestion problem at the intersection of First Avenue and Thirteenth Street.

In summary, Scenario M can function effectively with the mitigating actions described above. The major emphasis in the mitigation program is on public transportation and includes both increases in the level of service and traffic-related actions which will allow transit vehicles to operate more effectively in the Yard.

C. CHARLESTOWN AREA SETTING

Charlestown, although a residential neighborhood for over 300 years, has long served as a major funnel for traffic travelling to and from Boston. The past fifteen years, however, have brought major changes to the transportation facilities which most impact Charlestown. In the mid-1970's the relocation of the Orange Line to the west and the subsequent removal of the elevated tracks, eliminated a blighting influence and served as an important catalyst for neighborhood redevelopment. It also, however, made rail transit service less accessible for many Charlestown residents, forcing greater reliance on bus service which is subject to variations in traffic.

The closing of the Navy Yard in the early 1970's and the transfer of most of the property to the City opened up a new and desirable waterfront area for commercial and residential redevelopment. Now the highway ramps connecting the Tobin Bridge (Route 1) with I-93 and downtown Boston, which have long been a blighting influence on the City Square area, are being moved to the west side of I-93. The Central Artery North Area (CANA) project, which will take five years and cost over $400 million, will not only remove a blighting physical influence but will create new parcels of land. Figure 1 shows the boundaries and street system of the Charlestown neighborhood, while Figure 2 shows the City Square area in its post-CANA configuration.

Accompanying these changes in the transportation system have been major changes in the character of the neighborhood itself. Proximity to downtown Boston has led to an increase in housing prices and an influx of new residents. Charlestown has seen a major reduction in its population from over 40,000 prior to World War II and 30,000 in 1950, to only 13,000 today. Although the character of the area has changed and the population has declined, the transportation-related concerns of the neighborhood are similar to those of the past. These are the impact of through traffic, improved public transportation and adequate parking for neighborhood residences and businesses.

D. OVERVIEW OF ANALYSIS PROCEDURE

This memorandum summarizes the findings of an analysis of traffic conditions in the Charlestown City Square/Chelsea Street area. This area is the focus of the initial effort because most of the new development in Charlestown will be concentrated there. Recent traffic impact work has concentrated on individual developments including the Navy Yard, the New England Aquarium and Tudor Wharf. This study involves a transportation analysis of all major potential development in this area. It is important to recognize that assumptions were made concerning development on parcels for which no definite plans exist, such as the CANA parcels. An analysis of traffic impacts was conducted for two development scenarios. One scenario (D) involved a "maximum" build-out, while the other one (M) involved a more realistic "metered" build-out. Table 1 summarizes the assumed land use distribution for each of the three scenarios.

The traffic analysis was conducted beginning with the major access point to the area, City Square. Under the new City Square configuration being developed under the CANA project, most traffic travelling to and from the Navy Yard and Chelsea Street will pass through this intersection. All traffic coming from downtown Boston, I-93 or Route 1 must pass through this intersection. Some traffic from

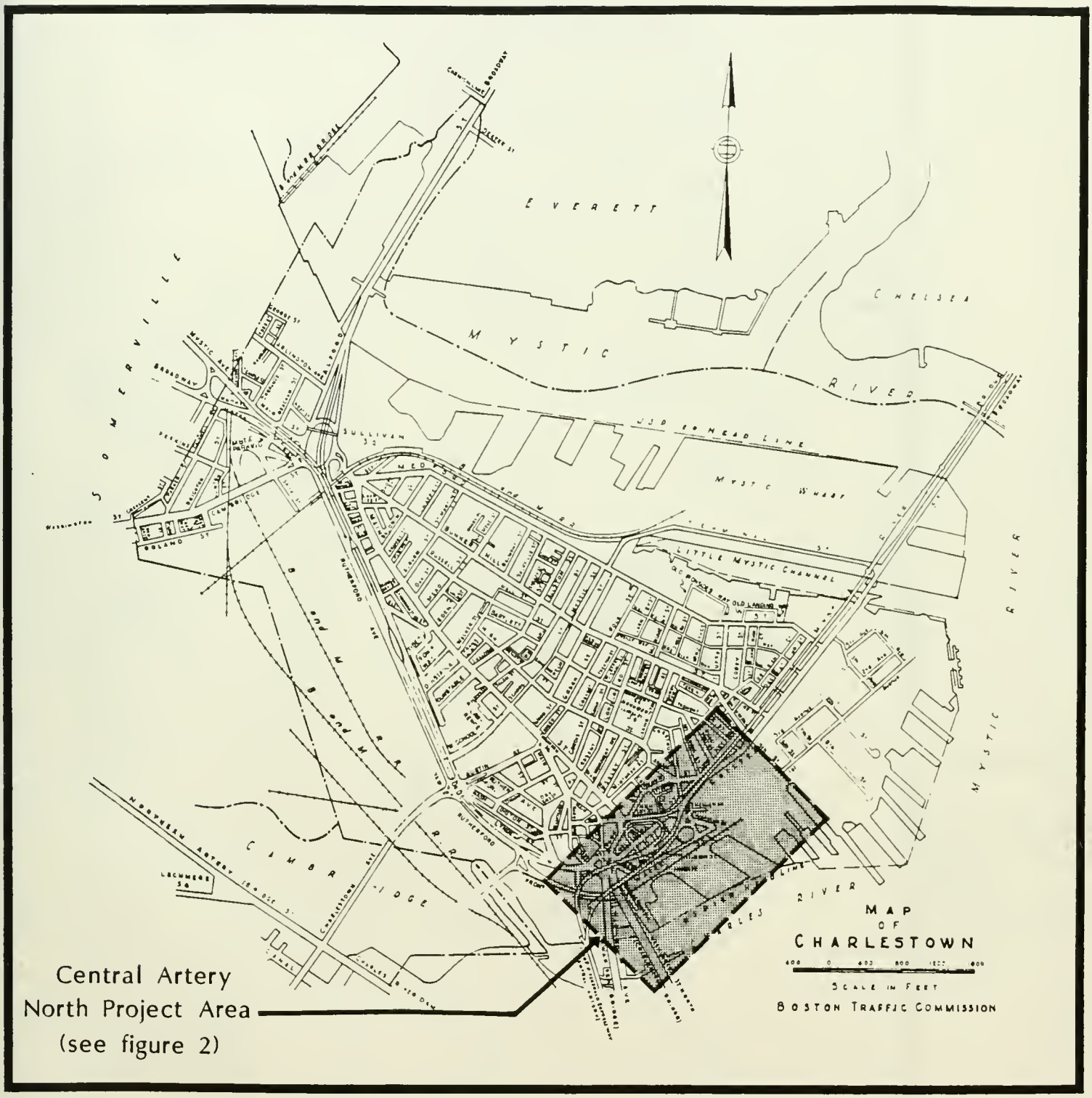


FIGURE 1

CHARLESTOWN NEIGHBORHOOD

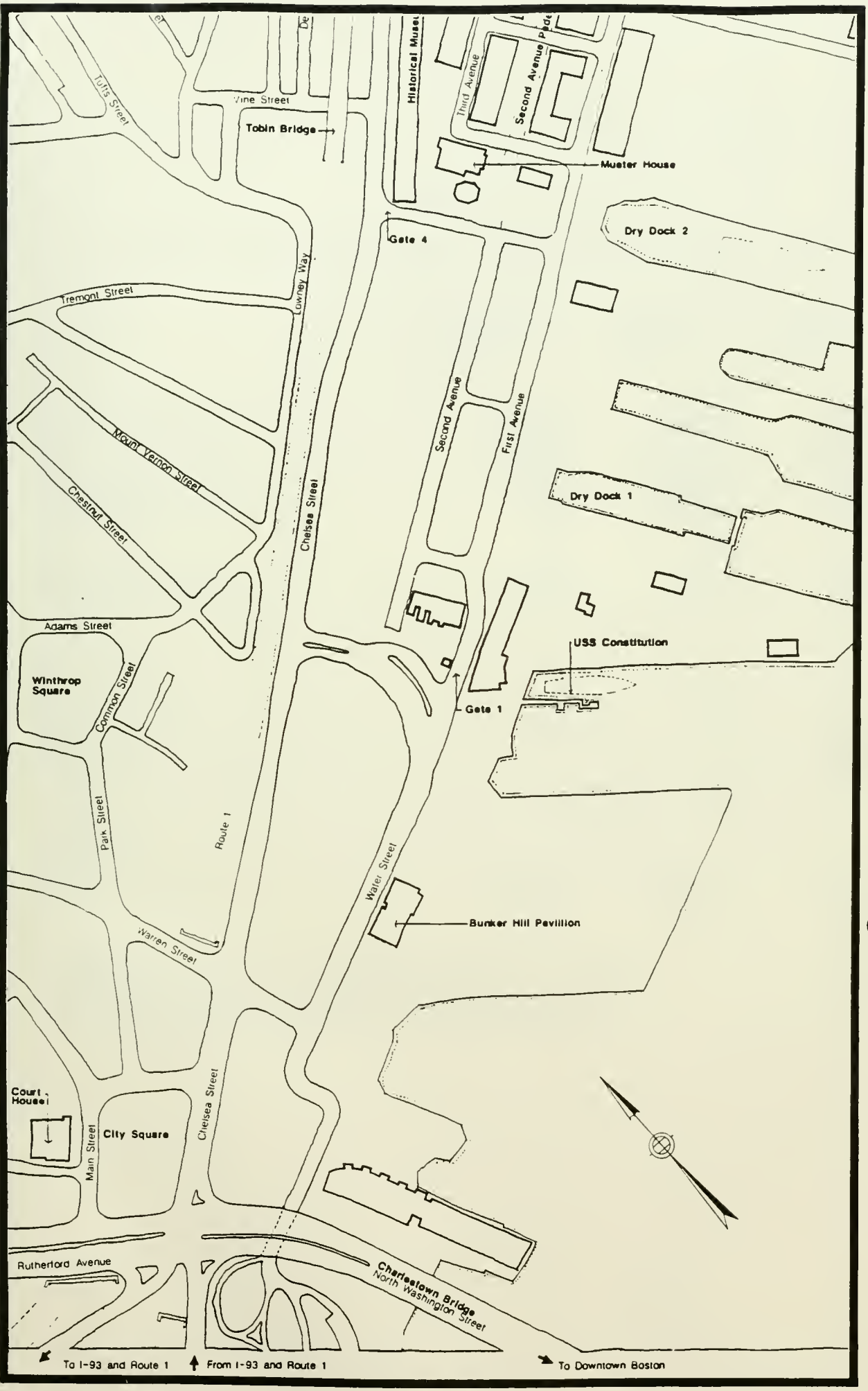


FIGURE 2

CITY SQUARE
AREA
AFTER CANA
PROJECT

Table 1

DEVELOPMENT ASSUMPTIONS FOR NAVY YARD/CITY SQUARE/CHELSEA ST. AREA

	Scenario M 1995	Scenario M 2000	Scenario D 2000
NAVY YARD			
Housing Units	1,811	1,811	1,921
Office (Sq. Ft.) *	469,000	519,610	585,700
Research/Institutional (Sq. Ft.)*	1,334,500	1,478,890	2,342,800
Retail (Sq. Ft.)	213,500	229,500	276,300
Aquarium (Sq. Ft.)	322,000	322,000	322,000
Other Exhibit (Sq. Ft.)	0	179,000	195,000
Hotel Rooms	400	400	400
Parking/Commercial	3,743	3,957	3,365
Parking/Residential	1,582	2,182	2,077
CANA PARCELS			
Housing Units	0	200	136
Office (Sq. Ft.)			140,500
Retail			38,000
Hotel Rooms			110
TUDOR WHARF			
Office (Sq. Ft.)	249,510	249,510	249,510
Commercial (Sq. Ft.)	30,574	30,574	30,574

* Research/Insitutional includes both medical research and institutional office employers such as the Boston Redevelopment Authority and the Massachusetts Water Resources Authority

the north can access the area from Sullivan Square via Main, Bunker Hill and Medford Streets. However, it is an important objective of both the neighborhood and the City to limit traffic on neighborhood streets. Thus, traffic conditions in City Square should not be allowed to deteriorate to the point that delay encourages traffic to and from the north to seek alternative routes through the Charlestown neighborhood streets.

As a result of these considerations, the City Square intersection was analyzed first for each development scenario. Working toward the Navy Yard, the major intersections along Chelsea Street providing access to the Navy Yard (Gate 4, Medford Street and Gate 5) were examined next. If both City Square and the Navy Yard entrances could accommodate the traffic, then the key internal intersections were also examined for each scenario.

Because of the assumed presence of the New England Aquarium in both development scenarios for the Navy Yard, and the fact that one-third of Aquarium visitors are projected to visit in July and August, the peak period for traffic in the area will be in July and August. Therefore, the analysis period used was a weekday in August. It should be noted that these peak conditions will occur for approximately two months of the year.

In addition, to an analysis of traffic conditions a number of improvements and mitigating actions were identified and assessed. Transportation mitigation measures include intersection improvements, alternative parking arrangements and public transportation improvements.

E. INTERSECTION LEVEL OF SERVICE CRITERIA

The traffic analyses conducted relies on the analysis of intersection level of service measures for the evaluation of impacts of the development scenarios. The criteria for both signalized and unsignalized intersections are described below. Analysis of traffic capacity and operations was conducted using methodologies described in the 1985 Highway Capacity Manual, Special Report 209.

1. Signalized Intersections

Level of service for signalized intersections is defined in terms of the average stopped delay per vehicle. The criteria are summarized in Table 2, below:

TABLE 2

LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

Level of Service (LOS)	Stopped Delay Per Vehicle (Seconds)
A	≤ 5.0
B	5.1 to 15.0
C	15.1 to 25.0
D*	25.1 to 40.0
E	41.0 to 60.0
F	> 60.0

* Level of Service D is generally considered acceptable in urban areas.

2. Unsignalized Intersections

In capacity calculations for an unsignalized intersection or driveway, the assumption is made that the major street traffic is not affected by the minor street movements. The capacity of the intersection is a function of: the right turns into the major road; the left turns from the major road; through traffic crossing the major road and left turns into the major road; and the number of acceptable gaps in the through traffic streams which allow turning or crossing vehicles to pass through the intersection. The critical acceptable gap is defined as "that gap for which an equal number of drivers will accept a shorter gap as will reject a longer gap."

Based on a gap acceptance function, the capacity of the minor approach can be determined. The difference between available capacity and existing demand is defined as reserve capacity and is used as the criteria for determining level of service. The relationship between the level of service, reserve capacity and expected traffic delay is summarized in Table 3, below:

TABLE 3

LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS

Reserve Capacity (PCPH)**	Level of Service	Expected Delay to Minor Street Traffic
≥ 400	A	Little or no delay
300 - 399	B	Short traffic delays
200 - 299	C	Average traffic delays
100 - 199	D	Long traffic delays
0 - 99	E	Very long traffic delays
*	F	*

* When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection. This condition usually warrants improvements to the intersection.

** PCPH = Passenger Cars Per Hour

F. SCENARIO D - DEVELOPER'S PROPOSED BUILD-OUT YEAR 2000

This sections describes in detail the assumptions and findings for the transportation analysis of the full build-out scenario for both the Charlestown Navy Yard and the adjacent land parcels.

1. Scenario D - Transportation Characteristics

The key characteristics and assumptions used in the analysis of the Scenario D are as follows:

- The Navy Yard will be built-out by year 2000 under the scenario shown in Table 1.

- Eighty per cent (80%) of the employees in the Navy Yard would be employed by major institutional employers such as Massachusetts General Hospital resulting in an average number of employees in Navy Yard office space of one per 400 square feet.

- In year the 2000, 45% of office workers in the Navy Yard would use means other than automobile to travel to and from work, primarily public transportation. There are two components to this figure. Just over 50% of the employees who work for major institutions would use means other than automobile, while 20% of those who work in smaller offices and retail establishments would use means other than automobile. The first group constitutes 80% of total Yard employees; the latter group 20%. This level of non-auto use is similar to that found in the Navy Yard today.

- The parcels created by the Central Artery North Area (CANA) would be developed by Year 2000 as suggested in the 1986 "Guidelines for City Square" prepared for the Commonwealth of Massachusetts by Childs, Bertman, Tseckares and Casendino, Inc.

- The New England Aquarium would be developed in the Navy Yard at Drydock #2 with 700 dedicated parking spaces located in Yard's End. Some overflow parking for the Aquarium may be provided in areas away from the Navy Yard. Travel patterns for the Aquarium would be the same as those described in the recent feasibility report prepared by TAMS for the New England Aquarium ("Draft New England Aquarium Charlestown Navy Yard Relocation Transportation Analysis", February 15, 1989).

- The U.S.S. Constitution will have an annual visitation rate of 1.0 million per year in the year 2000 (a 40% increase from the current level of about 700,000), with modal splits and traffic distributions similar to those described in the February, 1987 report "Visitor Statistics and Information, Boston National Historical Park", prepared by the U.S. National Park Service. It was assumed that 25% of those who visit the Constitution will also visit the Aquarium; this was based on a recent survey by the New England Aquarium.

- Traffic generated by the Tudor Wharf development will be equal to that proposed for alternative #2 in the Draft Environmental Impact Report prepared for Tudor Wharf by Fort Point Associates in October, 1988. The development assumptions related to Tudor Wharf are shown in Table 1.

- Background traffic volumes on Chelsea Street not generated by the specific land uses described above were increased by a total of 5% between 1989 and year 2000. Although residential growth in the neighborhood was only projected to be in the range of 1% to 2% (based on projections prepared by the BRA for the Central Artery/Third Harbor Tunnel Project), a higher figure was used to account for possible increases in autos per household. A 5% increase to the year 2000 was also used to estimate traffic to and from the Moran Container Terminal. This figure was based on discussions with Massport. Some Massport property, as well as the former Amstar plant, may be used for transport of workers during the construction of the new Massachusetts Water Resources Authority Deer Island Treatment Plant. Plans for this are not finalized at this time, however, so no volumes were included. In any case this usage will be temporary.

- Background traffic projected for City Square was estimated by using the 1991 projections prepared for the CANA Project by the Central Transportation Planning Staff (CTPS). These were then factored by 1% annually to forecast traffic for the year 2000. Because this traffic is primarily downtown-oriented, the 1% background growth figure used by TAMS to estimate traffic in the Midtown Cultural District was also considered to be reasonable in City Square.

- It was assumed that the plan for the City Square intersection proposed by Vanasse/Hangen/Brustlin for the Boston Transportation Department, and described in a report of November, 1987, will be implemented. The implications of this plan, along with additional modifications which were tested as part of this analysis, are discussed in the following section.

2. City Square Improvements

In November 1987, Vanasse/Hangen/Brustlin (VHB) undertook a study of the local intersections in the vicinity of the CANA project, including the new City Square intersection. A number of layout modifications to the Massachusetts Department of Public Works (DPW) scheme were recommended to improve the capacity, as follows:

- Dual left turn lanes to Chelsea Street on the Rutherford Avenue approach (southbound).
- An exclusive right turn lane to Chelsea Street on the Charlestown Bridge approach (northbound).
- An exclusive left turn lane to Rutherford Avenue on the I-93 off-ramp (eastbound).

The VHB scheme, which is now under consideration by the Massachusetts DPW, is shown in Figure 3.

3. Scenario D - Traffic Analysis Findings

The summary of estimated year 2000 vehicle trips generated by Scenario D, both in and outside the Navy Yard, is shown in Table 4. The summary of traffic impacts under this scenario is shown in Table 5, and illustrated for the Navy Yard area in Figure 4.

a. City Square Intersection

As discussed above, the first step in the analysis process was to determine whether City Square could accommodate the forecast level of traffic. During the morning peak hour, level of service (LOS) E was found for the City Square intersection, with average delays of 51 seconds. All approaches would operate at LOS E, with the exception of the Chelsea Street approach, which would operate at LOS D. During the evening peak hour, LOS F was found for the overall City Square intersection and on all approaches, with average delays of 80 seconds.

Improvements to the layout of City Square were then investigated to determine whether an acceptable level of service could be achieved. First, the Chelsea Street approach was widened to provide an exclusive lane for right turning traffic to Rutherford Avenue. This would release both of the through lanes for exclusive use by through traffic to the I-93 on-ramp. Additional land would be required in the northeast quadrant of the intersection, and no modifications to the remainder of the intersection would be necessary. A sketch of this modification is shown in Figure 5.

Analysis of this change shows that there would be no significant improvement to the intersection during the morning peak hour, with overall LOS E still prevailing, although there would clearly be an improvement for right turning traffic from Chelsea Street. During the evening peak, some improvement in delays

FIGURE 3

CITY SQUARE INTERSECTION

(VHB DESIGN)

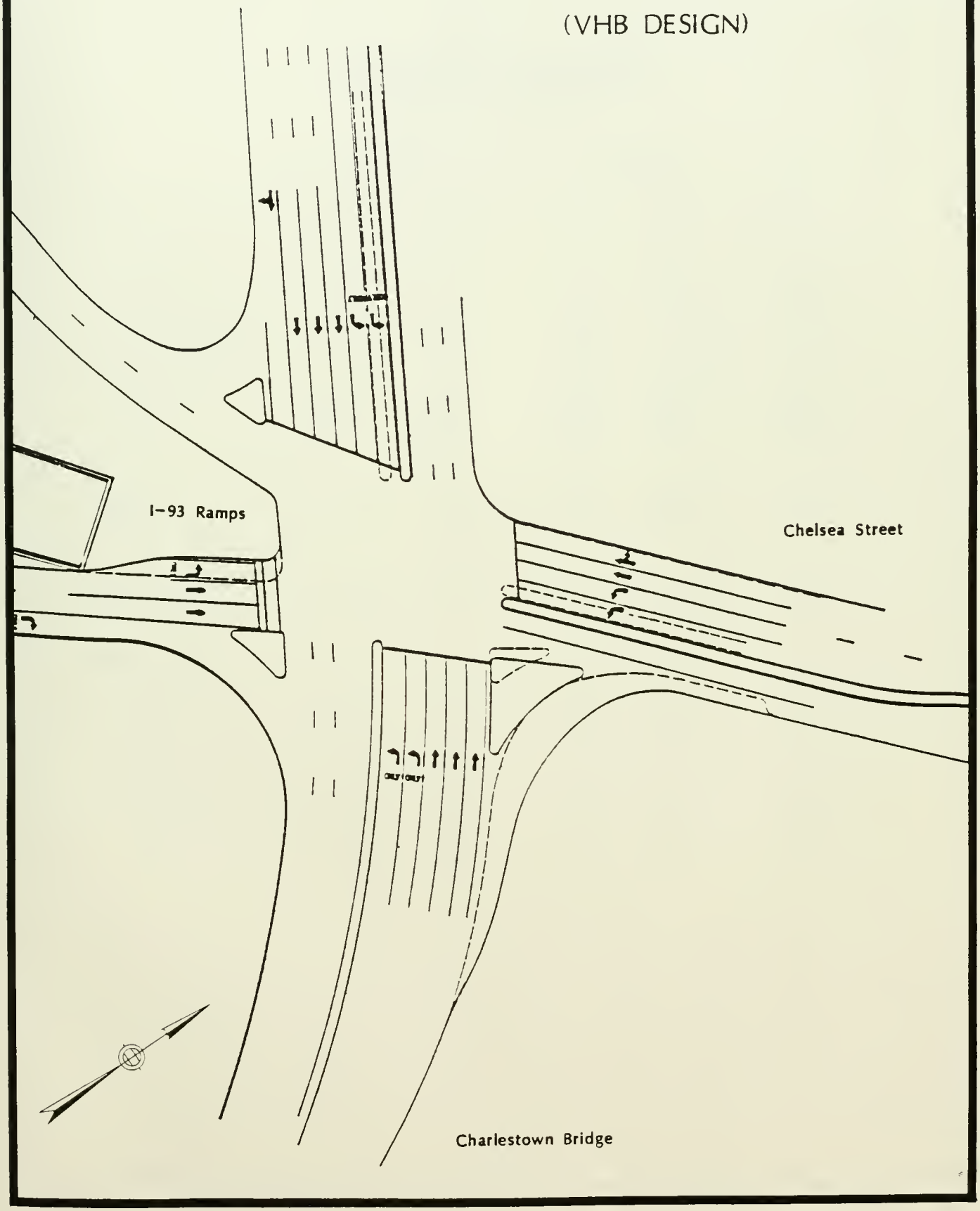


Table 4

Charlestown Navy Yard Development
Vehicle Trip Generation
Scenario D - 2000

	AM Peak		PM Peak		Total
	In	Out	In	Out	Daily
NAVY YARD					
Office	1,206	123	150	1,124	6,814
Retail	36	30	135	139	2,782
Residential	153	536	536	230	7,662
Hotel	155	78	78	103	2,584
Total	1,550	767	899	1,596	19,842
AQUARIUM	46	0	154	506	3,196
NATIONAL PARK SERVICE	5	5	40	90	766
TUDOR WHARF					
Office	152	22	27	142	1,090
Retail	13	6	36	38	734
Restaurant	3	0	17	7	316
Total	168	28	80	187	2,140

Table 5

Charlestown Navy Yard Development
Scenario D - Year 2000
Level of Service Summary

	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
Signalized:				
City Square				
VHB geometry	51.18	E	79.87	F
+ WB RT lane	51.84	E	64.92	F
+ WB TH and NB TH lane	39.91	D/E	48.14	E
VHB with 60% transit	40.78	D/E	68.34	F
Gate 4/Chelsea St	25.22	C/D*	24.40	C/D*
Gate 5/Chelsea St				
With added NB lane	36.87	D*	73.26	F

* At least one move operates at level of service "E" or "F"

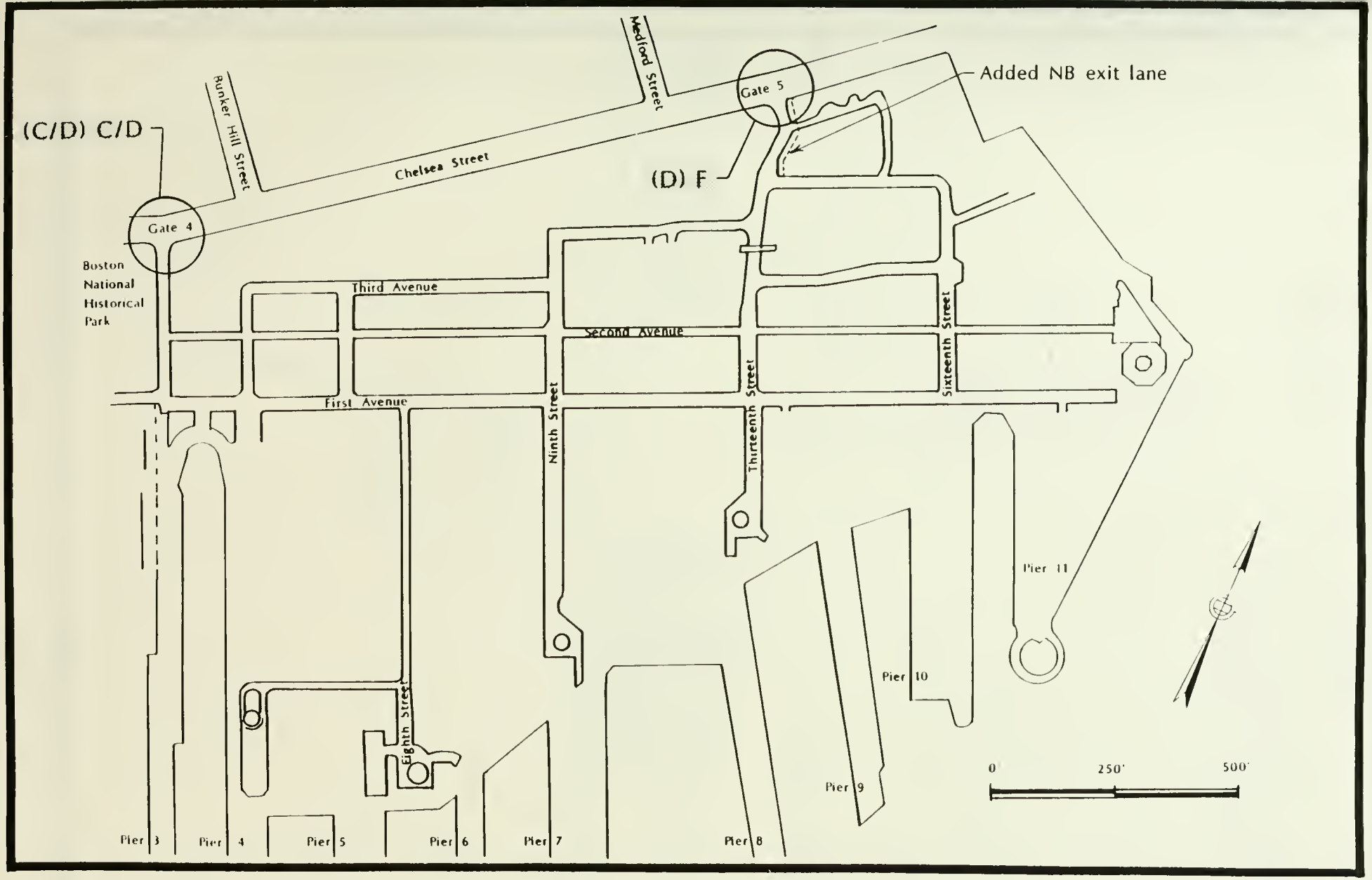


FIGURE 4

CHARLESTOWN NAVY YARD

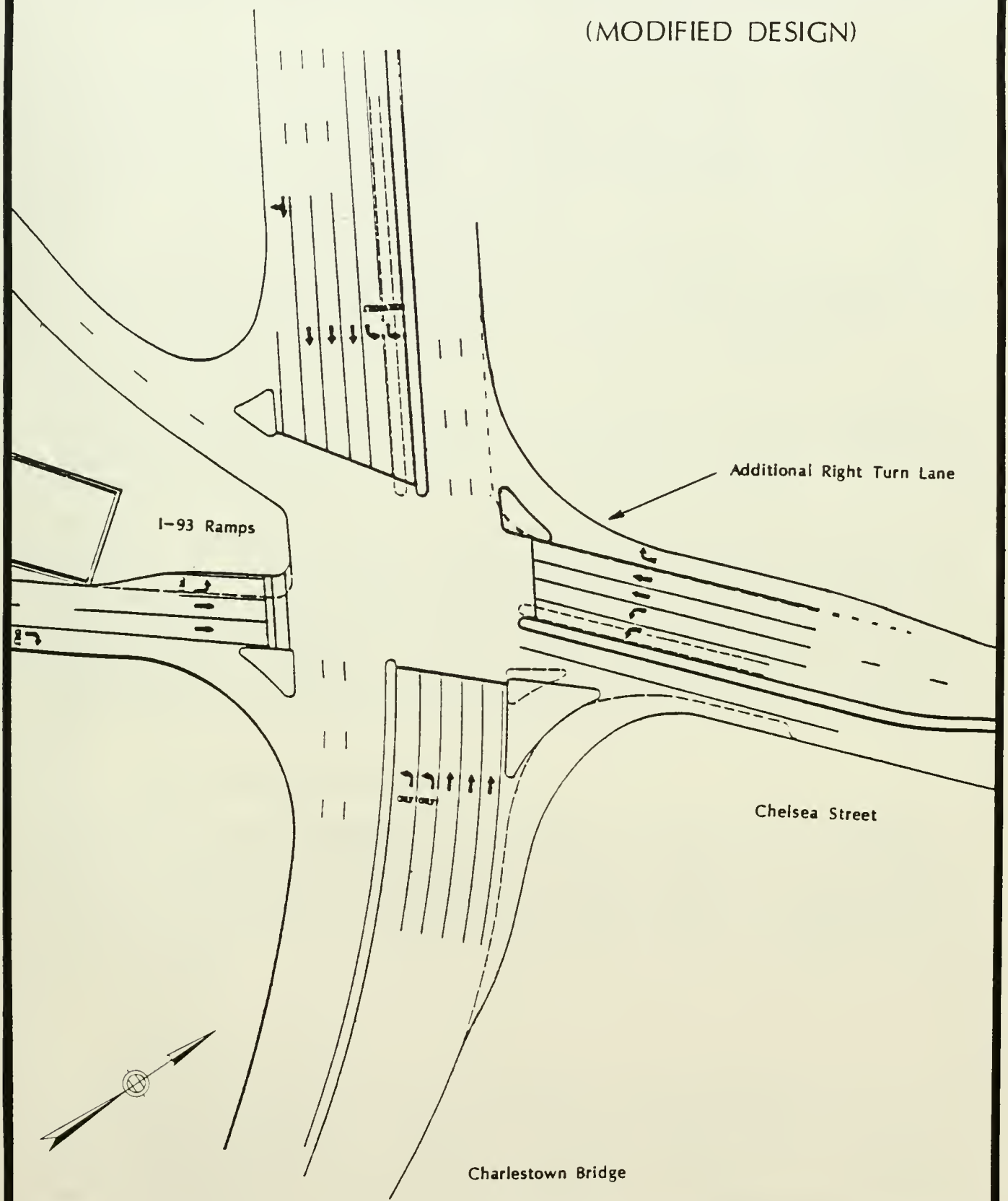
SCENARIO D LEVEL OF SERVICE – 2000

(AM PEAK) PM PEAK

FIGURE 5

CITY SQUARE INTERSECTION

(MODIFIED DESIGN)



was found, but the overall level of service remained at F, with LOS F on all approaches except Chelsea Street, which would be improved to LOS E.

Second, in addition to the exclusive right turn lane on Chelsea Street, an additional lane was included for through traffic from Chelsea Street to the I-93 on-ramp. This would create three lanes on that approach for exclusive use by through traffic. It was also assumed that the right turn lane on the Charlestown Bridge approach would be increased in length to ensure that it would not be blocked by through traffic queues. Again, both modifications would require additional land, which appears to be available. Additional engineering analysis would be required, however, to confirm this.

The inclusion of the additional through lane on Chelsea Street would, however, require that the I-93 on-ramp be modified, so that a transition could be provided between the three lane entry and the two lane exit from the intersection. This necessary modification may not be feasible, due to the relatively short distance to the point where the ramp diverges to I-93 north and I-93 south.

Despite this likely design difficulty, analysis was performed for these changes. LOS D/E was found in the morning peak hour, with LOS D on all approaches except the Charlestown Bridge from downtown, which would be at LOS F. During the evening peak hour, the intersection would be improved to LOS E, with LOS E on all approaches except Chelsea Street, which would be at LOS D.

Further improvements to the City Square intersection do not appear to be feasible. An extensive number of lanes already provided, and it is not realistic to add any further lanes, as the intersection would be wholly out of context with the remainder of the surrounding roadway network. It is therefore concluded that the full build-out under Scenario D can not be satisfactorily accommodated at the City Square intersection. If the City Square intersection does fail, traffic trying to exit from Chelsea Street will probably divert to local Charlestown Streets such as Warren, Bunker Hill and Medford during the evening peak period. This is clearly an undesirable outcome.

b. Navy Yard Gates Intersections

Analysis of the Gate 5/Chelsea Street intersection indicates it will operate at Level of Service F under Scenario D, even when an additional exit lane is added. The Gate 4/Chelsea Street intersection has lower projected volumes and would operate satisfactorily if an additional exit lane is added (it also fails without the additional exit lane). If Gate 5 fails and Gate 4 does not, commuters would use First Avenue to access Gate 4, thus creating a major congestion problem within the Yard.

c. Mode Split Sensitivity

In order to test the sensitivity of the analysis findings for Scenario D to the level of transit usage, forecasts were developed using a 60% non-auto modal split for Navy Yard employees. This modal split would assume either that 70% of institutional employees and 20% of non-institutional Navy Yard employees use means other than auto to travel to and from work, or that 67% of institutional employees and 30% of non-institutional employees do so. Under this scenario,

City Square improves over the 45% transit scenario, but continues to operate at Level of Service F during the PM peak hour. Given that a transit modal split of 60% is probably not realistic with a built-out Navy Yard, it appears that City Square cannot function under Scenario D.

4. Scenario D - Parking Requirements

The parking requirements of Scenario D are also significant and would be difficult to accommodate within the Navy Yard. Just over 6,600 parking spaces would be required in the Navy Yard under this scenario, a number which could be reduced to 5,800 if joint use of residential and office parking were allowed. Under the concept of joint use parking a portion of the residential parking spaces, which would be vacant during the day, would be used by Navy Yard workers and Aquarium visitors.

G. SCENARIO M - METERED BUILD-OUT 1995

The metered build-out program for 1995 reflects a plan for the Navy Yard which is similar to that proposed by the BRA in May, 1988, in terms of office/retail square footage and residential units. It also includes the relocated New England Aquarium at Drydock #2, increased visitation to the U.S.S. Constitution, and the development of Tudor Wharf. The phased build-out program would permit additional development to take place beyond 1995 both in the Navy Yard and on the CANA parcels if goals related to traffic mitigation and public transportation are met.

1. Scenario M - 1995 Transportation Characteristics

The key development and transportation characteristics associated with the Metered Build Scenario M in the year 1995 are as follows:

- The Navy Yard will be built to the level shown in Table 1 by year 1995.
- Seventy-five per cent (75%) of the employees in the Navy Yard would be employed by major institutional employers such as Massachusetts General Hospital, resulting in an average number of employees in Navy Yard office space of one per 360 square feet.
- In year 1995, 45% of office workers in the Navy Yard would use means other than automobile to and from work, primarily public transportation. There are two components to this figure. Just over 50% of the employees who work for major institutions would use means other than automobile, while 20% of those who work in smaller offices and retail establishments would use means other than automobile. The first group constitutes 75% of total Yard employees; the latter group 25%. Again, this represents a level of automobile use approximately equal to that experienced at present in the Navy Yard.
- No development would occur in the parcels created by the Central Artery North Area (CANA) by 1995.

- The New England Aquarium would be located in the Navy Yard at Drydock #2 with 700 parking spaces supplied in the area of Yard's End. For purposes of this analysis it was assumed initially that the entire peak August weekday demand for Aquarium parking (1,100 to 1,200 spaces) would be met inside the Navy Yard. Since the Aquarium peak occurs in August it likely that additional spaces, beyond the 700 set aside, would be available due to the fact that many residents and employees would be on vacation. As a mitigating measure, strict limitation of Aquarium parking to 700 spaces was tested. Under this scenario it was assumed that the additional 500 spaces would be provided outside the City Square/Chelsea Street area and that visitors would be bussed from this site(s). Travel patterns for the Aquarium would be the same as those described in the recent feasibility report prepared by TAMS for the New England Aquarium ("Draft New England Aquarium Charlestown Navy Yard Relocation Transportation Analysis", February 15, 1989).

- The U.S.S. Constitution will have an annual visitation rate of 1.0 million per year in the year 1995 (a 40% increase from the current level of about 700,000), with modal splits and traffic distributions similar to those described in the February, 1987 report "Visitor Statistics and Information, Boston National Historical Park", prepared by the U.S. National Park Service. It was assumed that 25% of those who visit the Constitution will also visit the Aquarium; this was based on a recent survey by the Aquarium.

- Traffic generated by the Tudor Wharf development will be equal to that forecast for alternative #2 in the Draft Environmental Impact Report prepared for Tudor Wharf by Fort Point Associates in October, 1988. The development scenario for Tudor Wharf is shown in Table 1.

- Background traffic volumes on Chelsea Street not generated by the specific land uses described above were increased by a total of 2.5% between 1989 and 1995. Although residential growth in the neighborhood was only projected to be in the range of 0.5% to 1.0% (based on projections prepared by the BRA for the Central Artery/Third Harbor Tunnel Project), a higher figure was used to account for possible increases in autos per household. A 2.5% increase to the year 1995 was also used to estimate traffic to and from the Moran Container Terminal. This figure was based on discussions with Massport. Some Massport property, as well as the former Amstar plant, may be used for transport of workers during the construction of the new Massachusetts Water Resources Authority Deer Island Treatment Plant. Plans for this are not finalized at this time, however, so no volumes were included. In any case this usage will be temporary.

- Background traffic projected for City Square was estimated by using the 1991 projections prepared for the CANA Project by the Central Transportation Planning Staff (CTPS). These were then factored by 1% annually to forecast traffic for the year 1995. Because this traffic is primarily downtown-oriented, the 1% background growth figure used by TAMS to estimate traffic in the Midtown Cultural District was also considered to be reasonable in City Square.

- It was assumed that the plan for the City Square intersection proposed by Vanasse/Hangen/Brustlin for the Boston Transportation Department, and

described in a report of November, 1987, will be implemented. The implications of this plan are discussed in more detail in the previous section on the findings of Scenario D.

2. Scenario M - 1995 Traffic Analysis Findings

Table 6 summarizes the trip generation estimates for Scenario M in the year 1995. Table 7 shows the traffic impacts of Scenario M in terms of intersection level of service and Figure 6 shows the impact on City Square intersections.

a. City Square Intersection

Under Scenario M, in 1995 City Square operates at level of service D in the AM peak (average of 31 seconds per delay per vehicle) and at level of service D (average of 38 seconds per delay per vehicle) in the PM peak. The first improvement described for City Square in the Scenario D section, the addition of an exclusive right-turn lane from westbound Chelsea Street to northbound Rutherford Avenue, only improves the intersection slightly, with level of service remaining at D.

b. Navy Yard Gates Intersections

The Gate 5/Chelsea Street intersection requires the addition of an exit lane along Thirteenth Street from Chelsea Street back to Building 199. In addition, signalization of the Medford Street/Chelsea Street intersection and coordination with the Gate 5/Chelsea Street signal will be required. If these improvements are made, Gate 5/Chelsea Street will function at level of service C and Chelsea Street/Medford Street at level of service B/C. The Gate 4/Chelsea Street intersection will operate at level of service B without improvements.

c. Navy Yard Interior Streets Intersections

The key unsignalized intersections within the Navy Yard (First Avenue/Thirteenth Street and First Avenue/Fifth Street) will function satisfactorily under this scenario as well. The design of the parking at Yard's End should, however, attempt to minimize the pressure on the Thirteenth Street/First Avenue intersection by placing as much parking as possible between First Avenue and Gate 5. Good access to Thirteenth Street should be provided from these facilities.

3. Scenario M - 1995 Public Transit Requirements

A key component of effective transportation management in the Navy Yard is improved public transportation. The current major employers in the Navy Yard: the Boston Redevelopment Authority, the Massachusetts Water Resources Authority and the Massachusetts General Hospital, have achieved public transportation modal splits of over 50% as a result of aggressive ridesharing and vanpooling programs. While these programs should be continued, the additional development in the Navy Yard will require the addition of more traditional public transportation services. Besides transit service required for day-to-day commuter needs, the

Table 6

Charlestown Navy Yard Development
Vehicle Trip Generation
Scenario M - 1995

	AM Peak In	AM Peak Out	PM Peak In	PM Peak Out	Total Daily
NAVY YARD					
Office	797	81	99	743	4,502
Retail	26	22	85	91	1,976
Residential	145	505	505	217	7,224
Hotel	155	78	78	103	2,584
Total	1,123	686	767	1,154	16,286
AQUARIUM	46	0	154	506	3,196
NATIONAL PARK SERVICE	5	5	40	90	766
TUDOR WHARF					
Office	152	22	27	142	1,090
Retail	13	6	36	38	734
Restaurant	3	0	17	7	316
Total	168	28	80	187	2,140

Table 7

Charlestown Navy Yard Development
Scenario M - Year 1995/Metered Development
Level of Service Summary

	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
Signalized:				
City Square	30.61	D*	40	D/E*
With added WB RT lane	30.83	D*	37.57	D*
Gate 4/Chelsea St	9.64	B	13.32	B
Gate 5/Chelsea St				
With added NB lane	12.07	B	24.88	C/D
Medford St/Chelsea St	12.21	B	16.39	C

	AM Peak		PM Peak	
	R.C.	LOS	R.C.	LOS
Unsignalized:				
Thirteenth St/First Ave				
NB on Thirteenth St	733	A	381	B
SB on Thirteenth St	378	B	36	E
EB left from First St	1062	A	573	A
Fifth St/First Ave				
SB on Fifth St	615	A	572	A
EB left from Park	978	A	868	A

* At least one move operates at level of service "E" or "F"

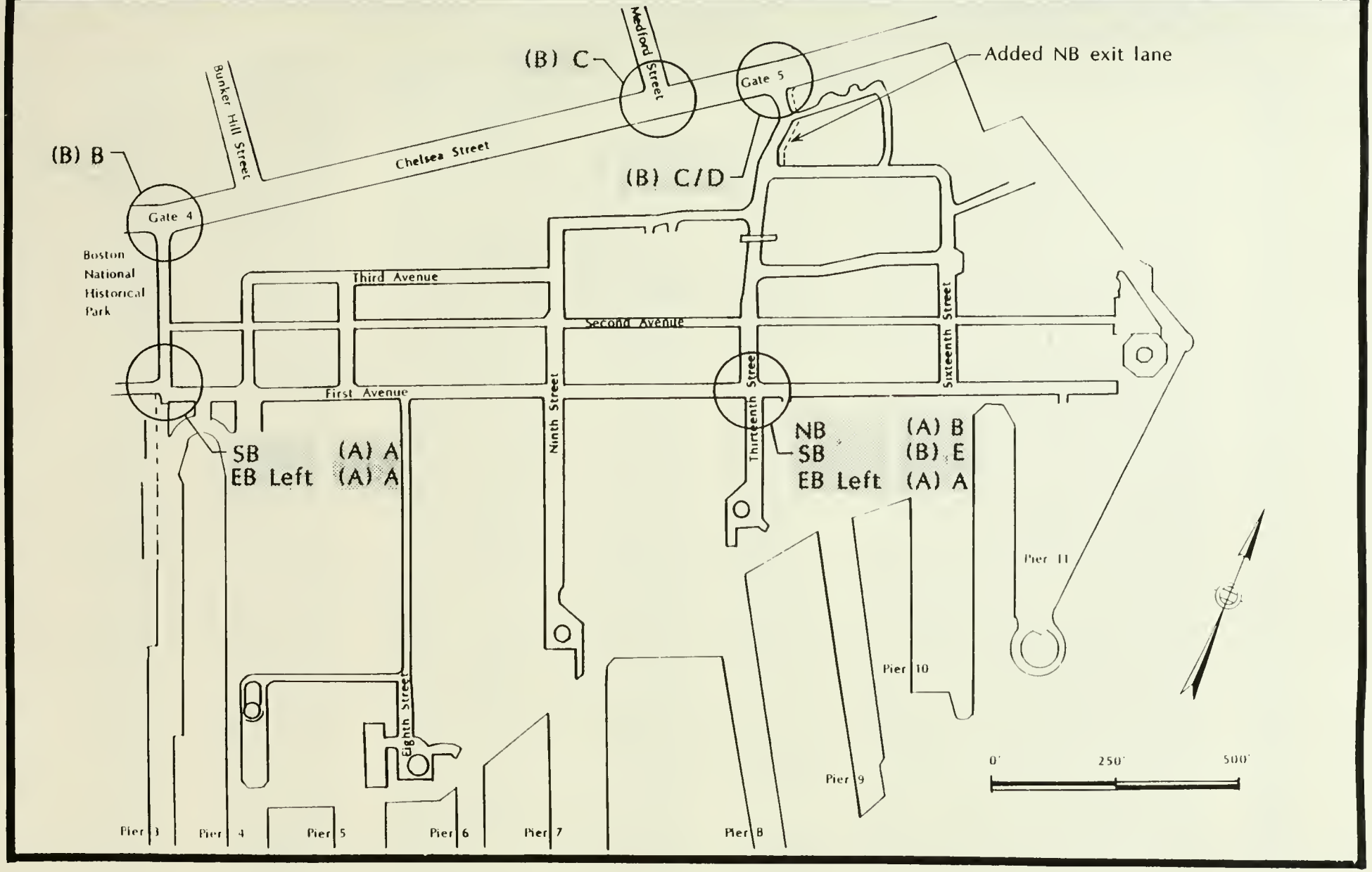


FIGURE 6

CHARLESTOWN NAVY YARD

SCENARIO M LEVEL OF SERVICE – 1995

(AM PEAK) PM PEAK

Aquarium is projecting that 25% of its visitors will arrive by means other than automobile. The level of transit service required to serve a built-out Navy Yard must include:

- Bus transit service with connections to the MBTA rail system at North Station (Commuter rail, Orange and Green Lines), Community College (Orange Line), Lechmere (Green Line) and Kendall or Charles (Red Line). The best route for improved bus service would be from City Square to Water Street, entering the Navy Yard via Gate 1 or 2 and traveling the length of First Avenue, exiting at Gate 5. The use of Gate 1 as an entry point is desirable due to the difficulties which would be experienced by buses attempting to arrive or leave via Gate 4. Analysis of that intersection shows that buses turning into the Yard via Gate 4 have to cross over into the outbound lane, creating both a safety hazard and traffic impediment. The entry of Gate 1 would be for transit vehicles only; its use for general traffic would cause significant traffic congestion within the Yard itself. The removal of parking along at least one side of First Avenue, and strict prohibitions on double-parking, will be necessary to allow transit service to function effectively within the Navy Yard. A more detailed explanation of the need to open Gate 1 is provided in the next section.

- A shuttle system would also be needed within the Navy Yard, running between the parking areas at Yard's End, the Aquarium at Drydock #2 and the National Park Service property at the western end of the Yard. This could probably be accomplished with either small buses, or in the summer, a tram system oriented toward Aquarium and National Park visitors.

- The current water shuttle service between Long Wharf and the Navy Yard will have to be expanded, especially in the summer time. Larger vessels will be required, seating up to 150 passengers, and more frequent service (15-minute headways rather than 30) may be needed. A shuttle service with stops at both the current dock and a new facility at Yard's End probably will be required.

Under scenario M, peak hour transit ridership to and from the Navy Yard is estimated at 1,600. If a split of 25% vanpool, 50% bus and 25% water transit is assumed for public transportation ridership, the peak hour ridership would be 400 on vans (requiring 17 to 20 vehicles per hour), 800 on conventional buses (requiring 11 to 15 vehicles per hour), and 400 on water transit (requiring two boats, providing service to downtown every 15 minutes). Average headways would thus be 3-4 minutes for vans, 5-6 minutes for buses and 15 minutes for the water shuttle.

In most cases, actual ridership will be lower than estimated here, since a percentage of visitors to the Aquarium and the National Park will walk. In addition, those figures, as well as the traffic forecasts will be reduced by people who both live and work in the Navy Yard. This will be more common than today once the Navy Yard is fully developed. Planning, however, must account for bad-weather days when walking will not be feasible.

For the Aquarium parking shuttle connecting Yard's End and Building 199 to Drydock #2, peak ridership will occur between the hours of 1:30 and 2:30 P.M., on Saturdays in August with a total ridership of 2,100. Peak ridership in one direction would be 1,100. If 10 minute headways are assumed, two trams each

accommodating 100 passengers, would be needed. This assumes that all visitors who park at Yard's End and Building 199 would ride the shuttle. Except in bad weather, however, a large proportion would probably walk.

F. SCENARIO M - METERED BUILD-OUT 2000

The phased build-out program for scenario M reflects an additional 400 housing units and an additional 200,000 square feet of office space which would be permitted by 2000 if the transportation system successfully functions under Scenario M. In addition, 195,000 new square feet of exhibit space would be provided. This development would be added to the development assumptions used in Scenario M for the year 1995. Under the metered build-out program additional development would be permitted beyond 1995 only if goals related to traffic mitigation and public transportation are met.

1. Scenario M - Year 2000 Transportation Characteristics

The key development and transportation characteristics of Scenario M in the year 2000 are similar to those described in the previous section for 1995, with the two additions in the Navy Yard described above. Other new developments related to the year 2000 are as follows:

- Two-hundred (200) housing units would be developed on the parcels created by the Central Artery North Area (CANA) Project by 2000.

- 1995 visitation levels for both the New England Aquarium and the National Park Service property are projected as "steady-state" visitation levels. Therefore the same levels are projected for both 1995 and 2000.

- Background traffic volumes on Chelsea Street not generated by the specific land uses described above were increased by a total of 5% between 1989 and year 2000. Although residential growth in the neighborhood was only projected to be in the range of 1% to 2% (based on projections prepared by the BRA for the Central Artery/Third Harbor Tunnel Project), a higher figure was used to account for possible increases in autos per household. A 5% increase to the year 2000 was also used to estimate traffic to and from the Moran Container Terminal. This figure was based on discussions with Massport.

- Background traffic projected for City Square was estimated by using the 1991 projections prepared for the CANA Project by the Central Transportation Planning Staff (CTPS). These were then factored by 1% annually to forecast traffic for the year 2000. Because this traffic is primarily downtown-oriented, the 1% background growth figure used by TAMS to estimate traffic in the Midtown Cultural District was also considered to be reasonable in City Square.

2. Scenario M - Year 2000 Traffic Analysis Findings

Table 8 summarizes the vehicle trip generation for Scenario M in the year 2000, indicating a small increase in traffic over 1995. The traffic impacts for

Table 8

Charlestown Navy Yard Development
Vehicle Trip Generation
Scenario M - 2000

	AM Peak In	AM Peak Out	PM Peak In	PM Peak Out	Total Daily
NAVY YARD					
Office	883	90	110	823	4,988
Retail	30	25	114	117	2,316
Residential	145	505	505	217	7,224
Hotel	155	78	78	103	2,584
Total	1,213	698	807	1,260	17,112
AQUARIUM	46	0	154	506	3,196
NATIONAL PARK SERVICE	5	5	40	90	766
TUDOR WHARF					
Office	152	22	27	142	1,090
Retail	13	6	36	38	734
Restaurant	3	0	17	7	316
Total	168	28	80	187	2,140

Scenario M in the year 2000 are shown in Table 9, while Figure 7 shows the impact at key Navy Yard intersections.

a. City Square Intersection

Under Scenario M in the year 2000, City Square operates at level of service D in the AM peak (average of 33 seconds of delay per vehicle) and at level of service E (average of 44 seconds per delay per vehicle) in the PM peak. The first improvement previously described for City Square in the section on Scenario D, the addition of an exclusive right-turn lane from westbound Chelsea Street to northbound Rutherford Avenue, would bring this intersection to level of service D/E (average of 40 seconds of delay per vehicle). An additional action which could be taken is the strict limitation of Aquarium parking in the Navy Yard to 700 spaces. The remainder, or overflow parking, could be accommodated outside the City Square-Chelsea Street corridor. Removal of this additional traffic from City Square would improve the City Square level of service to D/E (average of 39 seconds of delay per vehicle) during the year 2000 PM peak hour. This would require a good information system , such as electronic message signs, to guide visitors to the desired parking locations.

b. Navy Yard Gates and Internal Intersections

The other study area intersections, both inside and outside of the Yard, will function satisfactorily under Scenario M in the year 2000. While overall, the level of service for the First/Thirteenth Street intersection is acceptable, southbound traffic on Thirteenth Street entering the intersection does experience level of service E. As described in scenario M for the year 1995, this could be addressed by shifting more of the parking supply north of First Avenue so that it does not go through the intersection. Alternatively, the intersection of First Avenue and Thirteenth Street could be signalized.

Signalization of the Medford Street/Chelsea Street intersection and coordination with the Gate 5/Chelsea Street signal will be required. If these improvements are made, Gate 5/Chelsea Street will function at level of service C/D and Chelsea Street/Medford Street at level of service C at PM peak hour. The Gate 4/Chelsea Street intersection will operate at level of service C without improvements.

3. Scenario M - Year 2000 Public Transit Requirements

The public transportation improvements described for Scenario M in the year 1995 would be adequate to serve the incremental demand generated by year 2000. PM peak hour transit ridership to and from the Navy Yard is estimated at 1,840. If a split of 25% vanpool, 50% bus and 25% water transit is assumed for public transportation ridership, the peak hour ridership would be 460 on vans (requiring 20 to 24 vehicles per hour), 920 on conventional buses (requiring 12 to 16 vehicles per hour), and 460 on water transit (requiring 2 boats). Estimated headways would be three minutes for vans, 4 to 5 minutes for bus service and 15 minutes for the water shuttle. In most cases, this ridership will be lower, since a significant percentage of visitors will probably walk, and no provision has been made for people who would both live and work in the Yard. Planning, however, must account for bad-weather days when walking will not be feasible.

Table 9

Charlestown Navy Yard Development
Scenario M - Year 2000/Metered Development
Level of Service Summary

	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
Signalized:				
City Square				
All Aquarium parking in Yard	32.94	D*	44.02	E
Aquarium parking in Yard limited to 700 spaces			39.48	D/E
With added WB RT lane	32.55	D*	40.46	E
Gate 4/Chelsea St	10.13	B	16.45	C
Gate 5/Chelsea St				
With added NB lane	14.90	B/C	24.42	C/D
Medford St/Chelsea St	25.02	C/D	17.35	C

	AM Peak		PM Peak	
	R.C.	LOS	R.C.	LOS
Unsignalized:				
Thirteenth St/First Ave				
NB on Thirteenth St	715	A	381	B
SB on Thirteenth St	355	B	36	E
EB left from First St	1049	A	577	A
Fifth St/First Ave				
SB on Fifth St	589	A	548	A
EB left from Park	968	A	848	A

* At least one move operates at level of service "E" or "F"

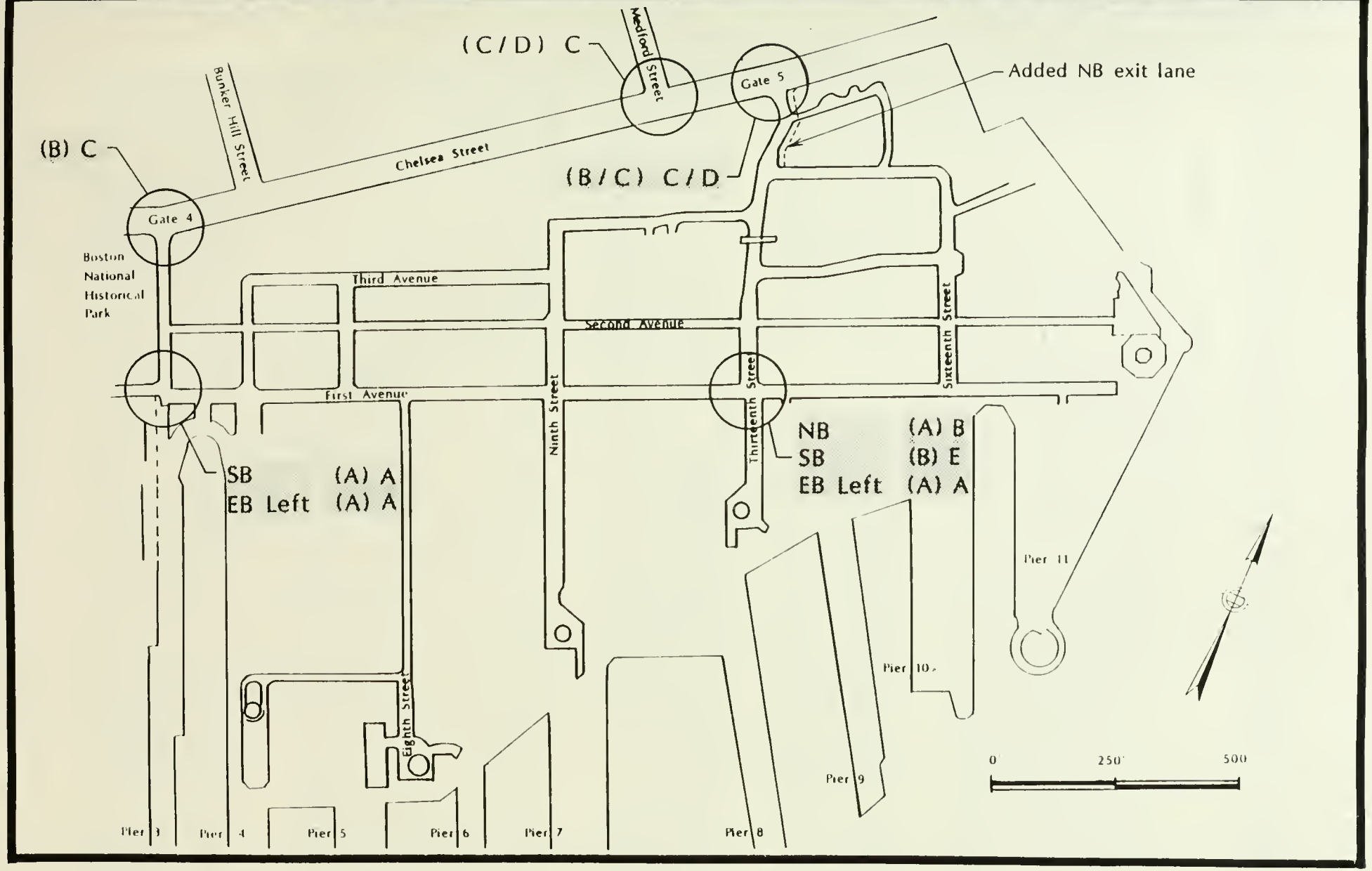


FIGURE 7

CHARLESTOWN NAVY YARD

SCENARIO M LEVEL OF SERVICE – 2000

(AM PEAK) PM PEAK

Since Aquarium ridership would be the same as that assumed in Scenario M for 1995, the ridership estimate for the parking shuttle would be the same.

G. SCENARIO M - PARKING REQUIREMENTS

The analysis indicates that 5,300 parking spaces would be required to meet peak demand in the year 1995, including the 700 spaces set aside for the New England Aquarium. The two major users are residents (2,200 spaces) and office/research workers (1,800 spaces). With joint use of parking spaces, the need could be reduced by just under 800 spaces to 4,500. By year 2000 under Scenario M, the demand will increase to 5,650 spaces, with 4,850 required under a joint use arrangment. The added demand results from 200,000 additional square feet of office space proposed and the opening of two new museum exhibits. The concept of joint usage is explained in more detail below, along with the assumptions related to parking demand generation.

Parking demand estimates were based on employee densities, transit use estimates, and average vehicle occupancy estimates used in the previous TAMS' transportation studies for the Navy Yard. These assumptions are summarized in the attached Table 10. The second and third lines refer to the "Units" described in the top line. For example, it was assumed that office employment density is 5.0 employees/1000 square feet. This figure was then applied to the proposed build-out (573,500 square feet for office space under Scenario M - 1995).

For the hotel, it is assumed that one parking space per room is required and that build-out will be 400 rooms. Attendance refers to the percentage of total workers who actually work at their primary place of employment on an average day. Eighty-five per cent (85%) is the standard used by the U.S. Census Bureau to account for illness, vacation and travel away from the office. For a facility like MGH, the 85% figure may be too high, since many of the employees will probably spend part of their time at the main MGH facility.

Projected transit modal splits were applied to office and office/research and retail employment only; for other uses modal splits were kept constant, as shown in Table 8. A transit modal split was not applied to residential units, since the parking space/residential unit figure used (1.24) reflects current ownership patterns in the Yard. As a result, the effect of transit ridership on auto ownership is already accounted for. For each of these scenarios, two estimates of parking space requirements were developed assuming that residential spaces were jointly used by daytime workers. The maximum rate of joint usage was calculated using a model developed for the Urban Land Institute which estimates the percent of spaces occupied by time of day. Based on this model it is expected that about 40% of the residents who park their cars in the Yard at night can be expected to drive their cars out of the Yard during daytime working hours. These spaces then become available to daytime employees.

As mentioned in the traffic section, the most desirable location for parking facilities is between First Street and Chelsea Street near Thirteenth Street and Gate 5. This will enable office-oriented traffic to enter and leave the Yard without impacting the First Avenue/Thirteenth Street intersection or residential areas on the water side of the Yard. The mix of activity currently proposed for Parcels 4, 5, 6 and 7 appears well-suited to joint use of parking. Under the proposed development pattern, it appears that parking can be made conveniently

Table 10
Charlestown Navy Yard Development
Input Assumptions for Navy Yard Parking Analysis

	OFFICE	OFFICE/ RESEARCH	RETAIL/ EXHIBIT	HOTEL	RESIDENTIAL
UNIT	Employees/1000 sf	Employees/1000 sf	Spaces/1000 sf	Spaces/Room	Spaces/Unit
NUMBER/UNIT	5.0	2.0	2.0	1.0	1.24
ATTENDANCE	85%	85%	NA	NA	NA
TRANSIT	45%	45%	NA	NA	NA
AVE. VEHICLE OCCUPANCY	1.3	1.3	2.5	NA	NA

accessible to both office workers and residents.

H. OPERATION OF TRANSIT VEHICLES THROUGH NAVY YARD GATES

The low numbers of transit vans and buses, as compared to the total volumes of all traffic using the gates, is unlikely to significantly impact the levels of service at the Chelsea Street intersections. An important issue related to transit, however, is physical access to the Yard; that is whether or not the intersection geometry of the gates will allow movement of transit vehicles to take place without encroaching upon other traffic movements, or causing danger to pedestrian movement.

The layout of each gate, as determined by observation and from available construction plans, was checked against bus maneuvering criteria, to evaluate their ability to accommodate the full sized (40 foot) vehicle used by the MBTA and tour and school bus operators. Generally speaking, no significant difficulties are experienced by transit vans; however it is appropriate to test the situation for the largest type of vehicle likely to be in operation. The assessment of each gate is summarized as follows:

1. Gate 1

The layout at this gate has been modified to provide a pull-out arrangement along Water Street in front of the gate for pick-up and drop-off of visitors. Only nominal provision for access by vehicles through the gate itself has been made. Gate 1 is therefore not suitable in its present form to accommodate buses, despite the straight alignment and extensive width of the roadway inside the gates.

There is potential, however, to modify the gate so that it could easily accommodate bus movements, and there is ample space available to achieve a suitable intersection layout. The location of the gate on the outside of the bend in the Water Street alignment would make it particularly suitable for the entry of buses from the west.

2. Gate 4

The existing layout of the Gate 4 intersection is constrained by the presence of the National Park Service wall and the adjacent Rope Walk building (which is an historic structure). While Gate 4 could be widened to provide a third lane on Fifth Street, this would be an expensive improvement. When completed, Chelsea Street will have two through traffic lanes in either direction, and ideally any bus entering from City Square should do so from the curb-side lane. Although this is just physically possible, it requires the bus to cross over into the exit lane within the gate approach.

The extent of this crossover is reduced if the entering bus takes up an initial position in the outer eastbound traffic lane on Chelsea Street before making the right turn, but again significant encroachment would occur, and the maneuver from that lane is not ideal in any event. In either case, it would be necessary to set back the stop line of the exit lane to avoid buses impinging upon exiting

traffic, but this would have a detrimental impact upon the level of service of the intersection.

As far as exit movements of buses are concerned, the turn to the west presents no serious difficulty, but the turn to the east would involve a slight crossover into the westbound through traffic lane on Chelsea Street. Again, some setting back of stop lines would resolve this difficulty, but to the detriment of the intersection level of service. In summary, the Gate 4 intersection is not well-suited for use by large buses, even if it were widened.

3. Gate 5

Like Gate 4, there is a difficulty under the current Gate 5 layout for buses making the entry from City Square. Crossover into the exit lanes would again occur, particularly from the curb-side lane entry, requiring the exit stop to be moved back some distance. Buses turning out of the gate would not experience any such difficulty.

At this location there is potential to provide dual exit lanes, which are likely to be required in any event. The difficulty for buses entering from City Square could therefore be eased, although a wholly satisfactory arrangement may prove difficult to achieve, and the gate is therefore more ideally suited for exit movements only.

4. Recommendations

The analysis shows that there are certain practical limitations on the use of large buses at Gates 4 and 5. These gates are ideally best suited for only exit movements to the west, although, with some improvement, it may be possible to also accommodate entry from the west at Gate 5. This may, however, impose less than ideal constraints on the capacity or layout of the Gate 5/Chelsea Street intersection.

By contrast, there is potential to modify the layout of Gate 1 to provide good arrangements for buses entering and exiting, particularly from the west. Accordingly, the optimum arrangement for buses serving the Navy Yard seems to involve the entry of buses from City Square at Gate 1 and exiting to Chelsea Street at Gate 5. In addition, it may be possible to provide for entry from City Square at Gate 5, with buses exiting at Gate 1 to the west.

I. CONCLUSIONS

The maximum build-out described under Scenario D cannot be accommodated by either City Square or the Gate 5/Chelsea Street intersection even under highly optimistic projections of public transportation ridership. The Metered Build-Out, Scenario M, can be accommodated by the City Square, Gate entrances and internal Yard intersections, with some minor revisions. It is important to note that these conditions represent "worst-case" conditions, which will only exist for two months during the summer of the year.

Several mitigating actions have been identified in this report, which will help to alleviate the impacts of the additional development. The only additional improvement to City Square which appears feasible, beyond those proposed by the Boston Transportation Department, is the addition of an exclusive right turn lane from Chelsea Street westbound to Rutherford Avenue northbound. The development of remote parking facilities outside City Square, which would service Aquarium employees and about 20-30% of peak Aquarium parking demand would also be effective in mitigating this situation.

Improved public transportation service is critical if the street system is to function. Continuation of the current vanpool program, bus connections to the various rapid transit lines, bus access to the Yard via Gate 1, improved water shuttle service and special service between Yard's End and the Aquarium during the summer months are all important components of this program.

T A M S

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